From the Lab to the Neighborhood: Testing & Designing Magnetic Prototypes

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ABSTRACT em Português

A presente tese foi desenvolvida nos Estados Unidos da América entre Janeiro e Julho 2014, em colaboração com a University of Massachusetts (UMass) e surge no âmbito de um projeto – *Pathways: From the Lab to the Neighborhood: An Interactive Living Exhibit for Advancing STEM Engagement with Urban Systems in Science Museums.* O projeto resultou de uma parceria entre três universidades americanas, tendo sido liderado pela Umass e um Museu de Ciências local, o EcoTarium, localizado na cidade de Worcester. O principal objetivo foi o de criar uma exposição, denominada como *Ciências da Cidade,* que visasse o envolvimento de vários subtemas relacionados com os atuais problemas existentes nos centros urbanos e, consequentemente, dos seus habitantes. Esta exibição tem abertura marcada para 2016 e, como tal, ainda se encontra numa fase experimental. O foco da tese incidiu num dos subtemas desenvolvidos: o desenho do bairro ideal, cujo objetivo principal foi o de tentar compreender quais as tipologias de espaço público e verde que as pessoas mais prezam. Para o efeito, foram desenvolvidos protótipos e criados modelos para interagir com o público, tendo sido dada uma especial ênfase à categoria dos espaços verdes. Foram fornecidos tabuleiros metálicos com ímanes magnéticos aos visitantes, a fim de simularem e construírem o que consideravam ser o seu bairro ideal. O objetivo foi o de compreender como é que os participantes responderam à tarefa que lhes foi pedida, e, quais as principais diferenças entre os bairros construídos, face à idade e género dos intervenientes. Pôde-se concluir, que as árvores e os parques foram dos ímanes mais utilizados. A maior surpresa foram as coberturas ajardinadas (7 em cada 10 participantes, ou seja 70%, optaram por incluir este elemento no seu bairro). De igual modo, uma grande maioria, 70%, confessou preferir viver em moradias unifamiliares, num contexto tendencialmente suburbano e com mais espaços verdes (do que os que têm agora). Um dos propósitos deste estudo foi, também, o de entender o funcionamento deste projeto-piloto, as suas fragilidades e compreender se seria possível replicá-lo noutros museus e instituições. A resposta foi muito positiva e já foi demonstrado interesse por parte de outros museus americanos em implementar este mesmo sistema. No sentido em que se procura envolver a comunidade local no projeto, e se pretende compreender qual a sua opinião sobre o sitio onde gostariam de viver, e, quais as componentes que mais valorizam nos espaços que frequentam no seu quotidiano, o trabalho desenvolvido, também demonstra que se alarga para o campo das Ciências Sociais, uma área até aqui pouco explorada pela Arquitetura Paisagista.

Palavras-chave: Preferência de espaços; Comportamento Humano; Mapa Cognitivo; Psicologia Ambiental; Normas Culturais.

ABSTRACT in English

This dissertation was developed in the United States of America, between January and July 2014, in collaboration with the University of Massachusetts (UMass) in the scope of the project *Pathways: From the Lab to the Neighborhood: An Interactive Living Exhibit for Advancing STEM Engagement with Urban Systems in Science Museums.* The project results from a partnership between three American Universities, under the leadership of Umass, and the EcoTarium, a Science museum located in Worcester. The main goal was to create a new exhibition *City Science*, in order to explore the relation of people and the metropolitan environment. This exhibit will be launched in 2016 and is currently under an experimental phase. This thesis is specially focused in one of the *City Science* main sections - the design of the ideal neighborhood. The purpose of this section is to understand how participants perceive green and public spaces and how they envision their ideal neighborhood. With this in mind, we've developed prototyping models in order to interact with the visitors and to collect data for analysis. It was given a especial emphasis to the category of green spaces. The prototyping models consisted in providing a metal tray and a set of magnets to the participants. After, they were asked to build their ideal neighborhood. The goal was to comprehend the reaction of the visitors to the task and to recognize the main structural differences of the just built neighborhoods, considering factors like age and gender. We were able to conclude that trees and parks were among the most used magnets, but the biggest surprise was to realize that 7 out of 10 participants, 70%, used the magnet *Roof Garden.* A vast majority of the participants, around 70%, confessed preferring to live in a single-family house, in a suburban context and with more access to green infrastructures. Another main goal of this dissertation was to perceive the development of this pilot project in order to understand if it would be viable to replicate this model in other museums and institutions. This experience was quite positive since there are already other American museums predisposed to embrace a project of this kind. This study is straightly related with the field of Social Sciences once it pretends to involve the local community and understand their idea about the place they would like to live in. This is an important field of Landscape Architecture once the aim of this profession is to design people's spaces.

Key words: Space Preference; Human Behavior; Cognitive Map; Environmental Psychology; Cultural Norms.

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ABBREVIATIONS

App -	Application
CITI -	Collaborative Institutional Training Initiative
DGS -	Distinct Green Space
FCUP -	Faculdade de Ciências da Universidade do Porto
GSC -	Green Space Connectivity
i.e. -	*id est* (that is)
LARP -	Landscape Architecture and Regional Planning
LMU -	Loyola Marymount University
L Patch -	Large Patch
M Patch -	Medium Patch
NSF -	National Science Foundation
S Patch -	Small Patch
STEM -	Science, Technology, Engineering and Math education
Umass -	University Of Massachusetts
US -	United States

INTRODUCTION

1.1. Thesis Purpose and Goals

Landscape Architecture is a multidisciplinary field that has been growing over the last few years. It combines arts, science, design and environment in a synergic way, contributing for an aesthetic expression of the landscape space.

The fields of activity of a Landscape Architect are fairly wide and provide a variety of new opportunities. A great example of this is the project *Pathways: From the Lab to the Neighborhood: An Interactive Living Exhibit for Advancing STEM Engagement with Urban Systems in Science Museums.* Funded by the American National Science Foundation (NSF) for the next two years, this project results from the partnership of three American Universities and pretends to set up an exhibit in the EcoTarium, a science museum in Worcester, Massachusetts. Integrating a multidisciplinary team, this project emerges from the combined effort of an academic body lead by Prof. Robert Ryan[1] of the University of Massachusetts (UMass) and the EcoTarium. Inspired in the city of Worcester, the theme of this new exhibit is *City Science*. The intent is to explore the relation of people and the urban environment, the existing plants and native animals. Focused on 4 different exhibit design areas - Land Use & Land Cover, Urban Heat Island, Urban Biodiversity, and Neighborhood Design Areas (Ideal neighborhood) -, this project pretends to approach a contemporary subject associated many times with climate change issues. One of the aims of the exhibit is to capture visitors of all ages and transform this project into a replicable model of how science museums can depict urban ecology to the visitors.

As the title of this dissertation suggests - *From the Lab to the Neighborhood: Testing & Designing Magnetic Prototypes* – this project was focused in one of the main exhibit design areas, the Ideal Neighborhood. Since we're dealing with a pilot project, there aren't many publications directly related with this matter. This difficulty was taken as a challenge and lead to an intense field work. Therefore we established a specific methodology that

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[1] Professor Robert Ryan is the Principal Investigator (PI) of this project. This means he's the leader of team and responsible for the development of contents for NSF.

served a vital purpose – the development of a prototyping model in order to collect data for analysis.

This model was based on magnetic elements as a key to interact with the exhibit visitors. These have participated in prototyping sessions where they were given a metal tray, a set of magnets and finally asked to build their ideal neighborhood. The aim was to understand the impact that the different neighborhood typologies can have amongst people living in urban and suburban contexts.

Within the frame of this thesis the main goals are:

- To develop and test the creation of an ideal neighborhood model
- To assist the museum staff in the production and design of the magnets
- To give more emphasis to green areas and typologies
- To develop a methodology to 'read' the visitor's compositions: creation of patterns and green space typologies
- To understand the interaction between the developed model and the visitors: how do people of diverse age and gender react? Which type of neighborhood do they ideally build?
- To create a model that can be replicable in other museums of the world

On the 1st chapter of the dissertation we introduce the basic principles of this research. We expose the project and its details. On the 2nd chapter we considered important to present a brief literature review, including an historical context. The 3rd chapter describes the procedures and developed methodology. We explain step by step how the prototypes were designed and describe the process behind collecting data. The 4th chapter presents the results with the support of statistics, graphics and tables. In the 5th, we discuss and analyze the findings. Finally we present our vision for future research and opportunities.

1.2. The Project

The project *Pathways: From the Lab to the Neighborhood: An Interactive Living Exhibit for Advancing STEM Engagement with Urban Systems in Science Museums* has the intention of "developing a nationally-replicable model for integrating the newly-emerging science of urban systems into exhibits in urban science museums".

Taking place in the United States of America, this project will be piloted in the EcoTarium, a science museum designed for children, located in Worcester (40 miles from Boston). This new exhibit has the name of **City Science** and the aim to "explore the science of people's urban environment, which is around them all the time, but which they rarely stop to consider".

The University of Massachusetts (UMass) newspaper wrote: « *"From the Lab to the Neighborhood" is seen as a pilot for a national model to bring urban ecology research to science museums across the country. It will bring together staff from six other science museums in California and New England to review the exhibit prototypes, and to discuss how their museums can develop new urban ecology exhibits. This pilot project builds on preliminary exhibit planning already conducted by the EcoTarium staff and focuses on trying out these new exhibit ideas with visitor feedback. This study will inform the permanent exhibition, for which the EcoTarium is currently pursuing funding to complete.* In general this study will explore different aspects of cities and urban concerns, such as **neighborhood design and urban biodiversity**, the **land use & cover change areas**, **health** and well-being (including the impact of climate change and urban heat islands). Accordingly to the project final script, *these exhibits occur at multiple spatial scales (i.e., site, neighborhood, and urban region) and allow us to understand how information about impacts at these multiple scales influence people's perceptions of future scenarios regarding urban and environmental planning. The prototyping of these exhibits and the simultaneous formative evaluation provides the process to gather data on how different kinds of museum experiences might or might not lead people to alter the design of their ideal neighborhood* (Ryan *et. al.* 2013)

Figure 1 - Project's research team; From the left to the right: Dr. Paige Warren, Dr. Colin Polsky, Dr. Robert Ryan, and Dr. Eric Strauss

This project involves different teams that will be working together for the next two years. The images below show the Principal Investigators. This team was also part of the ULTRA project.

Dr. Paige Warren is a Professor in the Department of Environmental Conservation in Umass. She studies *the processes generating and maintaining biological diversity in a* world *that is becoming increasingly dominated by humans*. In this project her role is to develop prototypes related to wild animals that can be found within the cities (rats, birds, etc.).

Dr. Colin Polsky is the Associate Dean for Undergraduate Research & Active Pedagogy in the Graduate School of Geography at Clark University in Worcester (city where the EcoTarium museum is located). He is also a Professor and a Geographer, specialized in *Human Dimensions of Global Environmental Change.* Dr. Polsky also enrolled his students in the project - they're focused in developing maps and data about the land use & cover change areas.

Dr. Robert Ryan is the Principal Investigator of the Project and the person who I'm directly working with. He's a Professor in the Landscape Architecture and Regional Planning Department in UMass Amherst. Dr. Ryan is a specialist working with people and their perception about public parks and spaces. His role in this project consists of developing prototypes for the exhibits concerning people and what their ideal neighborhood would look like. Jane Buxton and I are his research assistants for this project.

Dr. Eric Strauss is the President Professor of Urban Ecology in Loyola Marymount University (LMU) in Los Angeles and Executive Director of the Center for Urban Resilience. He developed a national model for urban ecology field studies that will also inform the planning and prototyping of the exhibits and related materials (Price et al., 2011). Dr. Strauss runs a training center for high school teachers and has been fighting within the last few years for uniforming science education in America.

1.3. Research Questions

Accordingly to Booth et al., *the question is to find the makings of a problem, then turn it into a problem that guides your research.*

The first research question is correlated with the notion that participants have of space:

What do people consider the ideal neighborhood to be like? Do they know what they want?

S. Kaplan (1982) once said that *recognizing patterns is no simple task; the process is not only essential for perception it also forms the basis for how humans know and think about their environment.*

Second question involves perception as well but this time we introduce the factor gender to the equation: **Do parents and children have different perceptions about this issue?** Third is related with place attachment - **What do people retain in their minds about urban biodiversity?** Questions no. 3 and 4 are not as tangible as the previous ones but still they approach subjects that need to be studied and integrated in the study.

They might be more vague and theoretical but still we think they're a solid basis and engine to the investigation.

The last question associates the exhibit with the concept of learning outside the classroom – how can these kids and their parents learn something new with the magnetic neighborhood and how can we as organizers of the exhibit be sure that they "take" something home with them? So the 4th question is **how can we integrate the concept of *Informal Learning*, well-known in America, in this exhibit?**

1.4. Scope of Research & Organization of Dissertation

This project gave us the unique opportunity of working in a different environment, to contribute as researchers in a real, tangible study. It provided a good chance of promoting Landscape Architecture outside its ordinary context and at the same time to enroll and raise citizens' awareness for community concerns. The first step was to outline strategies and define which topics to approach considering the scope of this thesis. Next, we decided to explore the literature and existing bibliography, we opted to organize it into different units:

A. Environmental Psychology – Preference – Restoration
B. Place attachment – Urban – Nature
C. Education – Mapping – Design
C1. Informal Learning

While assembling the literature we began to participate in meetings and brainstorming sessions at the museum. The following step was to start organizing prototyping sessions, developing questionnaires and prepare school and parental consent forms. In order to be officially allowed to interview people on the behalf of the EcoTarium and UMass there was an established protocol to follow. The requirement was to complete an online course designated by CITI training[2] (Collaborative Institutional Training Initiative (CITI) human subjects online training program). Next, we started remodeling and rethinking the ideal neighborhood prototyping material designed by the EcoTarium. After, we began simultaneously processing the collected data and running the prototyping sessions. We worked and consulted different entities during this process: Clark University and Umass grad students, EcoTarium general staff, among others. As a personal *project* I went to visit Dr. Eric Strauss's in Loyola Marymount University in Los Angeles. The purpose of this visit was to learn more about his Urban Eco Lab *curriculum* a project that he has been developing for training high school science teachers.

[2] The training can be found under the *link http://www.umassmed.edu/research/irb/citi/* and is formed by several modules that describe research regulations and procedures as well as responsibility and ethical concerns that the researcher has to have in mind.

CHAPTER 2

CONTEXT OF STUDY

2.1. Historical Context & Current Trends

Research on learning science in informal environments reflects the diversity of theoretical perspectives on learning that have guided research. Over a century ago, scientists began to study thinking and learning in a more systematic way, taking early steps toward what are now called the cognitive sciences. During the first few decades of the 20th century, researchers focused on such matters as the nature of general intellectual ability and its distribution in the population. In the 1930s, they started emphasizing such issues as the laws governing stimulus-response associations in learning. Beginning in the 1960s, advances in fields as diverse as linguistics, computer science, and neuroscience offered provocative new perspectives on human development and powerful new technologies for observing behavior and brain functions. The result during the past 40 years has been an outpouring of scientific research on the mind and the brain—a “cognitive revolution,” as some have termed it. With richer and more varied evidence in hand, researchers have refined earlier theories or developed new ones to explain the nature of knowing and learning. Three theoretical perspectives of the nature of the human mind have been particularly influential in the study of learning and consequently in education: behaviorist, cognitive, and sociocultural. The relative influence of these perspectives over time has changed. Each emphasizes different aspects of knowing and learning with differing implications for educational practice and research (see, e.g., Greeno, Collins, and Resnick, in press). (Bell and others, 2009, 30)

A broad theory, or set of complementary perspectives, which could be refined through empirical testing, could help integrate the range of theories and frames currently in use and help generate core questions. To move in that direction, we propose an “ecological framework for learning in places and pursuits” intended to highlight the cognitive, social, and cultural learning processes and outcomes that are shaped by distinctive features of particular settings, learner motivations and backgrounds, and associated learning expectations. The term “ecological” here refers to the relations between individuals and their physical and social environments with particular attention to relations that support learning. The framework draws mainly from cognitive and sociocultural theories. Our proposal is consonant with other calls for using an ecological perspective for accounts of human development and learning that can accommodate a range of disciplinary perspectives as well as the diversity of life experiences in a global society (Barron, 2006; Lee, 2008). It builds on a tradition of scholarship on the ecological nature of human development. This tradition has long recognized and taken into account the compound set of influences on learning and development originating from a person's experiences across myriad institutional contexts and social niches (family, school, playground, peers, neighbors, media, etc.) (Bronfenbrenner, 1977). Within the ecological framework, we describe three cross-cutting aspects of learning that are evident in all learning processes: people, places, and cultures. Using each as a lens to examine learning environments enables us to tease out various factors at play in the learning process and better identify potential leverage points for improving learning. (Bell and others, 2009, 34)

One of the most important theoretical shifts in education research in the past few decades has been the recognition that all learning is a cultural process. Cultural theories regarding the nature of the mind, of intelligence, and of knowing and learning shape educational practices in a process through which they are more or less designed to conform with those theories. The theories, in turn, explain the practices. As Bruner summarized the situation: "How a people believe the mind works will, we now know, have a profound effect on how it is compelled to work if anybody is to get on in a culture. And that fact, ironically, may indeed turn out to be a robust cultural universal" (Bruner, 1996, p. xvii). Foundational work by Vygotsky, a contemporary of Piaget, offers insight into the cultural origin of human development. This conceptualization of culture is highly relevant to the ecology of science learning contexts. Educators often hold stereotyped notions of what counts as scientific reasoning and privilege a subset of sense-making practices at the expense of others (Ballenger, 1997). Yet research on scientific discussions and in active research groups reveals that many practices in which scientists engage are not recognized as useful or as a part of science in the classroom.

2.2. Theoretical Framework

This section was organized accordingly to the different themes that are being explored.

A. Environmental Psychology – Preference – Restoration

People not only get more out of an experience in a place they prefer, they are also more likely to go there in the first place. Places can be arranged so that they are easy to understand and will encourage exploration. When the needs of understanding and exploration are not met, people may feel frustrated and even threatened, adding to their fears and apprehension (Kaplan, Kaplan and Ryan 1998, 31). The concept of satisfaction without active use (Kaplan 1983, 147) is a phenomenon that has received some attention. Much of the way humans experience the environment is visual (Kaplan and Kaplan 1995, 207). Also remarkable, is the fact that people of different income levels and from different residential settings rate the importance of open space quite similarly. It is suggested that nature can be fulfilling and absorbing even without visible activity of any kind (Kaplan 1983, 148). Concerning preference and visual experience in the city, there are many factors to be considered. Complexity emerges as a factor that people prefer, but not a factor that can be view in isolation from other important influences. Familiarity was as effective a predictor as complexity and may well be a source of comfort (Herzog, Kaplan and Kaplan 1976, 641-2). Joan Nassauer is an expert in the field of Landscape & Residential preference. In one of her studies, she concluded that for American front yard landscapes, the cultural norm to conform to what the neighbors appear to prefer is stronger than cultural norms that favor particular conventional characteristics, like large areas of mown turf. Environmentally beneficial innovations in residential landscape design may be more successfully implemented at a scale of neighborhoods rather than only at the scale of individual properties. The conclusion that the appearance of the neighborhood dramatically affects what individuals prefer and what actions they might be likely to take in their own yards is consistent with US Census (2004) results, in which home owners who had moved within the previous year identified “looks and design” of their neighborhood as an important reason for choosing to live there, only somewhat less important than the house itself. While homeowners care a great deal about their own yards, they appear to care even more about how their yards contribute to neighborhood appearance (Nassauer, Wang, Dayrell 2009, 290). A similar study was conducted in Phoenix, Arizona in an effort to understand landscape preferences. The concept of dreamscape, Jencks (1993) is broadly explored, defined as “marketable and commodified landscapes designed to satisfy fantasies of urban history”. It is stated that income is an important predictor of preference for residential landscapes and different landscape styles vary in popularity amongst lower-, middle- and higher-income homeowners. Just as house types and styles have clear social class associations, so do landscapes. The degree of discrepancy between stated landscape preferences and landscape behavior is another important finding. One third of the respondents expressed landscape preferences that did not reflect their own landscape behavior (Larsen, Harlan 2006, 98)

B. Place attachment – Urban – Nature

Barker and White (1955), in their milestone ecological study of spatial behavior in American town, recommended that future research addresses the question, “What changes have occurred over the generations in the way children are reared?” Yet there seem to be no published findings on historical, intergenerational change in children’s use of neighborhood (Gaster 1991, 71)

The importance of urban nature is not arguable: high property values for houses adjacent to well-landscaped parks, lower housing turnover in areas that are well landscaped, “foliage” as a dominant theme in childhood memories of the city, and greater dissatisfaction with newer suburbs lacking in vegetation. People are willing to pay a monthly charge for their nearby nature (Kaplan 1983, 130-1)

If amount of knowledge and experience affect classification schemes, and if knowledge of and experience with particular environments differ between children and adults, then classification schemes of environmental “scenes”, as well as of associated functions or activities and attributes may be expected to differ as well. A related search conducted by Hart & Pazer (1982) found that children’s conceptions of cities and suburbs varied with age and travel experience. Children in this research generated many place categories that which are different from adult categories in the Tversky and Hemenway (1983) study. It suggests that their spontaneous generations of places are different. Idiosyncratic categories appeared to be “real” for the children producing them. Thus, it would seem that in order to talk to and teach children about places and objects in the world, it is important to understand “their” places and “their” objects (Pazer 1992, 20-5)

C. Education – Mapping – Design

People carry many internal maps in their minds. Some of these correspond to places and store spatial facts, but mental maps are not limited to geographical information. Such maps are the way that knowledge is stored in the head, and as such, we have maps for just about everything we know. Being told something is not a sufficient basis for creating a map (Kaplan, Kaplan and Ryan 1998, 23-4)

Considering an educational angle, Strauss developed an instructive model for science teachers in order to standardize the knowledge of American students and also to introduce some schools into the urban ecology and environmental studies field (Strauss et al. 2010).

C1. Informal Learning

Tim Zimmerman is a visiting assistant professor of cognition and education in Hampshire College. Accordingly to this University website, he *researches learning and teaching of ocean and environmental science concepts in non-school contexts (e.g., museums, environmental education excursions, field trips) and its relationship to environmental decision-making. He combines qualitative, quantitative and design-based research methodologies to study learners as they move spatially and temporally across informal-formal learning context boundaries.* Dr. Zimmerman collaborates in our project as an informal external advisor and guided me over the search of this topic. The concept of *informal learning* was introduced in the previous section (2.2.) but within this theme there are still ideas to explore. To understand whether, how, or when learning occurs, good outcome measures are necessary, yet efforts to define outcomes for science learning in informal settings have often been controversial. At times, researchers and practitioners have adopted the same tools and measures of achievement used in school settings. The six interrelated aspects of science learning covered by the strands reflect the field's commitment to participation—in fact, they describe what participants do cognitively, socially, developmentally, and emotionally in these settings.

Learners in informal environments:

Strand 1: Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.

Strand 2: Come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science.

Strand 3: Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world.

Strand 4: Reflect on science as a way of knowing; on processes, concepts, and institutions of science; and on their own process of learning about phenomena.

Strand 5: Participate in scientific activities and learning practices with others, using scientific language and tools.

Strand 6: Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science.

The strands are distinct from, but overlap with, the science-specific knowledge, skills, attitudes, and dispositions that are ideally developed in schools. Two strands, 1 and 6, are particularly relevant to informal learning environments. Strand 1 focuses on generating excitement, interest, and motivation—a foundation for other forms of science learning. Strand 1, while important for learning in any setting, is particularly relevant to informal learning environments, which are rich with everyday science phenomena and organized to tap prior experience and interest. Strand 6 addresses how learners view themselves with respect to science. This strand speaks to the process by which individuals become comfortable with, knowledgeable about, or interested in science. Informal learning environments can play a special role in stimulating and building on initial interest, supporting science learning identities over time as learners navigate informal environments and science in school. (Bell and others, 2009, 3-5)

There is a clear and strong commitment among researchers and practitioners to broadening participation in science learning. Efforts to improve inclusion of individuals from diverse groups are under way at all levels and include educators and designers, as well as learners themselves. Here are some ideas and conclusions of this committee: Informal settings provide space for all learners to engage with ideas, bringing their prior knowledge and experience to bear; Learners thrive in environments that acknowledge their needs and experiences, which vary across the life span. Increased memory capacity, reasoning, and metacognitive skills, which come with maturation, enable adult learners to explore science in new ways. Senior citizens retain many of these capabilities. Despite certain declines in sensory capabilities, such as hearing and vision, the cognitive capacity to reason, recall, and interpret events remains intact for most older adults (…) (Bell and others, 2009, 5)

Humans are inherently curious beings, always seeking new knowledge and skills. That quest for knowledge often involves science: from a child’s “Why is the sky blue?” to a teenager’s inquiry into the dyes for a new t-shirt; from a new homeowner’s concern about radon in the basement to a grandparent’s search for educational toys for a grandchild. Each of these situations involves some facet of science learning in a nonschool, informal setting (Bell and others, 2009, 11)

The informal education community pursues a range of learning outcomes. The idea of lifelong, life-wide, and life-deep learning has been influential in efforts to develop a broad notion of learning, incorporating how people learn over the life course, across social settings, and in relation to prevailing cultural influences. *Lifelong learning* is a familiar notion. It refers to the acquisition of fundamental competencies and attitudes and a facility with effectively using information over the life course, recognizing that developmental needs and interests vary at different life stages. Generally, learners prefer to seek out information and acquire ways of doing things because they are motivated to do so by their interests, needs, curiosity, pleasure, and sense that they have talents that align with certain kinds of tasks and challenges. *Life-wide learning* refers to the learning that takes place as people routinely circulate across a range of social settings and activities—classrooms, after-school programs, informal educational institutions, online venues, homes, and other community locales. Learning derives, in both opportunistic and patterned ways, from this breadth of human experience and the related supports and occasions for learning that are available to an individual or group. Learners need to learn how to navigate the different underlying assumptions and goals associated with education and development across the settings and pursuits they encounter. *Life-deep learning* refers to beliefs, ideologies, and values associated with living life and participating in the cultural workings of both communities and the broader society. Such learning reflects the moral, ethical, religious, and social values that guide what people believe how they act, and how they judge themselves and others. This focus on life-deep learning emphasizes how learning is never a culture-free endeavor. (Banks et al., 2007 in Bell and others, 2009, 28)

Everyday learning is pervasive in people's lives and includes a range of experiences that may extend over a lifetime, such as family or peer discussions and activities, personal hobbies, and mass media engagement and technology use. The agenda and manner of interaction in the environment are largely selected, organized, and coordinated by the learners and thus vary across and within cultures. Designed environments include museums, science centers, botanical gardens, zoos, aquariums, and libraries. Artifacts, media, and signage are primarily used to guide the learner's experience. While these environments are structured by institutions, the nature of the learner's interaction with the environment is often determined by the individual. Learners enter these environments primarily by choice, either their own personal choice or the choice of an adult (e.g., parent or teacher). Learners also have significant choice in setting their own learning agenda by choosing to attend to only exhibits or aspects of exhibits that align with their interests.

Typically, learners' engagement is short-term and sporadic in the setting, and learning takes place in peer, family, or mentor interactions. However, there is increasing interest in extending the impact of these experiences over time through post-visit web experiences, traveling exhibits, and follow-up mail or e-mail contact. (Bell and others, 2009, 47,48)

Science learning should be viewed as a lifelong, life-wide and life-deep endeavor that occurs across a range of venues focused on multiple outcome strands of interest (Bell and others, 2009, 49). Informal settings for science learning typically do not use tests, grades, class rankings, and other practices commonly used in schools and workplace settings to document achievement Nevertheless, the informal science community has embraced the cause of assessing the impact of out-of-school learning experiences seeking to understand how every day, after-school, museum, and other types of settings contribute to the development of scientific knowledge and capabilities (Bell and others, 2009, 50).

CHAPTER 3

MEASURING PERCEPTIONS AND DESIGNING NEW PROTOTYPES - RESEARCH METHODS

In this section we will clarify the logistics behind the organization of the prototyping sessions, the required procedures, the details of the 'game', how we approached the participants and the methodology developed for gathering data.

The EcoTarium has a characteristic philosophy when it comes to build a new exhibit. First, they start by testing their ideas with the visitors of the museum. They set up temporary conditions and begin by experimenting with basic and cheap materials like clay, cardboard or other stationary supplies. This process can take months and gradually the exhibit becomes more refined and outlined. For the final production the museum hires an external team of designers.

3.1. Research Design: Session by Session

In order simplify the comprehension of this chapter we will begin by explaining the development of every session individually. To date, five prototyping sessions[3] have been conducted. The first 2 (#0A and #0B) were organized by the EcoTarium staff by itself, and we as Umass team didn't play an active role, being there merely as observers of the exercise. Our team got involved in session #1, continued contributing along session #2, and organized session #3.
The first important thing to know is that in every session there was the existence of magnetic trays (size = 33x23cm). These were the first 'ingredient' we gave to a participant.

Session #0A – This was the first 'real' testing session and was led by the EcoTarium. It occurred in mid-February in North High School, a school located close to the museum. It happened in the 9th grade classroom and the museum staff began to distribute magnetic trays and magnet sets to the teenagers, asking them to set up their ideal neighborhood.

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[3] Each session was classified under a specific code (Ex. Session #1)

Session #0B – The following step was to monitor session #0B that took place in March in the museum floor. Again, we (as Umass) were only observing and opted to assume a similar role as in the previous session. This was being held by Clark University students and was organized in 2 parts. During the first hour participants were asked to draw their ideal neighborhood in a piece of paper. This system was not a success since people opted to sketch their own reality instead of their ideal. They ended up by zooming their houses in the drawing and forgetting about the neighborhood. The second hour was distinguished by the introduction of the magnetic trays and magnet sets. These were developed by the museum staff and consisted in 2 different versions: one designated as *children's* (Fig.2) and other labeled as *adults* (Fig.3 and 4). In general people ended up by accepting the challenge and got focused during a few minutes. While participants were 'playing', there was an observer responsible for writing down every reaction and conversation.

The main goal of this session was for us, as observers, to understand how to approach the participants and to learn how to act without intimidating the public.

Session 1# - This session occurred in the museum, at the end of April and in a very busy day. During the school year many of the state institutions organize field trips to visit the EcoTarium. When planning a prototyping session, the staff tends to take advantage of this type of situation since they reveal more productiveness and the visitors show more receptivity to new events. A different prototyping set was designed for this session. We decided to create a single version for all participants, despite their age. We've installed a large three-faced metallic board and fixed 3 posters representing 3 different environments – urban, suburban and rural; once the participants finished building their ideal magnetic neighborhood they were asked to place the magnetic tray in the board accordingly to their favorite context (urban, suburban or rural). There was also a big placard with the intent of exposing the existing magnets on the set. We interviewed 49 people during this session, mainly children, and the session lasted 3 hours (See appendices Pg. 57 Fig.56).

Session 2# - This session occurred short weeks after the previous one. It took place in the beginning of May in the EcoTarium. This time there weren't any field trips occurring on the floors and we ended up interviewing older people (than before) and museum staff. We tested exactly the same version as in session 1#. We interviewed 16 adults (See appendices Pg. 58 Fig.57).

Session #3 – The last session occurred in the center of Worcester, in the Farmer's Market. This market is famous amongst the inhabitants of the city for selling fresh and organic goods every Saturday. One of the reasons for organizing this session outside the EcoTarium is to involve the local community in the project. We manage to interview 20 people (See appendices Pg. 58 Fig.57).

3.2. Building the Ideal Neighborhood

The prototyping sessions #0A and #0B were essential to learn how to conduct the following ones. We understood from the beginning that there are many ways of formulating questions and that creating empathy with people is a significant key to obtain improved answers. Besides we encountered limitations in the magnet set that was being tested: we were working with two different versions designed by the EcoTarium. The one named as *Children's* was intended to be used by kids aged from the pre-kindergarten until

Figure 2 – Children's version: example of magnets

Figure 3 – Adult's version: example of magnets

Figure 4 - Adult's version: example of magnets

8 years old. The other, designated as *Adult's* was planned for children (and adults) of 8 and up. The children's set was built up by 15 magnets and was supposed to be intuitive and rouse kid's memories. The images, instead of showing simple and single elements like a pond or a specific green space or tree, displayed combined images, for example *grass for my dog* or *a pond for animals* or (Fig.2). This method of exposure turned up to be effective, kids did understand better what was being asked and at the same time they also built a mental connection with these elements. One of the big concerns of the museum staff was to control the space available to do the activity, as well as the number of magnets: people were *forced* into making choices and had to struggle to fit the most wanted elements. The EcoTarium exhibit developers organized a first (#0A) testing session in a local High School and covered part of the magnetic tray with a piece of paper in order to limit the available space. The Adult's version had 23 magnets organized by groups. The problem here was that the label didn't always correspond with the image and sometimes was difficult to understand what was meant. The graphic quality of the images

was also not consistent: different design styles and non-matching colors (Figs.3&4). With this in mind, we began to develop new ideas on how to contribute for the development of the exhibit, on how to incorporate Landscape Architecture and Planning in a more defined, palpable way. In session #0B these limitations were confirmed and we were given the opportunity for changing and redesigning the 'game'.

3.2.1. Details & Functioning - Methodology

Groups of Categories

The first step was to re-invent the categories of the magnets. In our perspective, it was necessary to pay more attention not only to green spaces in general but also to individual trees, bicycle and pedestrian paths, and public transport for example. With this in mind, we suggested the creation of distinct groups: (1) Residential Buildings; (2) Services; (3) Utilities; (4) Transportation Hub; (5) Transportation Corridors; (6) Green Spaces.

- (1) The group of Residential Buildings is formed uniquely by residential structures: Skyscraper, Apartment and House (Fig.5).
- (2) The group of Services stands for facilities that are often found in areas occupied by humans: Fire Department, School, Hospital, Museum & Theater, Place of Worship, Mall, and Local Store (Fig.6).
- (3) The Utilities set represents energy providers: Nuclear Power Plant, Wind Power and Solar Panel (Fig.7).
- (4) The Transportation Hub group is formed by Airport, Train station and Parking lot (Fig.8).
- (5) The section of Transportation Corridors is represented by long or short strips and is composed by Sidewalks, Bike lanes, Train tracks and Roads (Fig.9).
- (6) The group of Green Spaces is the most mature one, composed by different typologies of outdoor spaces: Playground, Park, Flower Garden, Plaza, Roof Garden, Cemetery, Vacant lot, Vegetable garden, Pond or Lake, Water stream and three different types of trees – evergreen, native and invasive (Fig.10)

The main concerns were to keep the 'game' simple, to reduce the number of items to the minimum (to have only essentials) and refine categories – choose accurately what we want to measure, especially in the Green Space group.

Figure 5 – Magnets that compose the category of Residential Buildings

Figure 6 - Magnets that compose the category of Services

Figure 7 - Magnets that compose the category of Utilities

Figure 8 - Magnets that compose the category of Transportation Hub

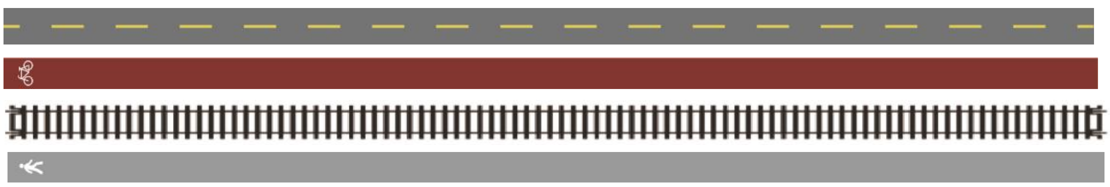


Figure 9 - Magnets that compose the category of Transportation Corridors

Figure 10 - Magnets that compose the category of Green Spaces

Graphic Design

Another important point was the consistency of the images chosen to represent the diverse categories. These were inspired in the Sims, a successful computer game that simulates real life and recreates natural and constructed ambiences. They were manipulated in Photoshop in order to become standardize, to have a consistent palette of colors and a uniform graphic design.

Size and Space

The issue of *space* and *proportion* was one of the main concerns of the museum staff for this round of prototyping sessions. With this in attention, the size of the magnets varies accordingly to the size and space occupied by the same elements in real life. For instance, they are organized in 6 different categories XS, S, M, L, XL & Strips.[4]

XS	2,54cm x 2,54cm	Individual trees
S	3,81cm x 3,81cm	Solar panel, Wind power, House and Store
M	6,35cm x 5,08cm	Everything not listed otherwise
L	7,62cm x 6,35cm	Parking lot, Mall and Hospital
XL	10,16cm x 7,62cm	Airport
Strips	20,32cm x 1,27cm	Roadways, Bike lanes, Pedestrian paths, Rail trail and Water stream.
“	10,16cm x 1,27cm	Same as line above but shorter

Production and Usability

All the materials used were provided by the EcoTarium. The manufacture (printing and cutting) of the magnets was taken care in the museum facilities and they introduced magnetic paper sheets in a common printer in order to produce them.

After the first session (#1) the team noticed that there occurred problems finding the *desired* magnets inside the bins and also managing them. During the activity it was common to find magnets with the printed part upside down. This compromised severely the creation of the ideal neighborhood, since people ended up picking the first piece they could grab and not the one they really wanted to have in their compositions. With this in mind we created double sided magnets, with the same image printed in both sides. This

[4] All the sizes are expressed in cm and articulate width versus height. The magnets are supposed to lie on a magnetic tray of the size 33cm x 23cm.

way it was easier for our public to manage the magnets and of course beneficial for the project since the attention span of our target is limited and slips easily.

3.3. Getting Involved: Questionnaires & Observations

After observing people creating their ideal neighborhood the procedure was to ask them a few questions in order to understand better their creations (See appendices Pg. 55). Here we present an example of a typical dialogue between observer and participant:

Observer**:** *Hi, would you like to participate in this activity? We are helping the EcoTarium to build a new exhibit and also doing research about people's ideal neighborhoods.*

Participant: *Yes!*

Observer: *Very well. I'm going to explain to you briefly how it works and then I'm going to observe you and take notes while you're doing the activity. Once you're finished I'll ask you a few questions about your neighborhood ok?*

Participant: Ok, sounds good.

Observer: *We are asking you to create your ideal, your dream neighborhood. I'm going to give you a magnetic tray and you have here all the magnets available (point to a printed sheet that shows all the options). They are organized by colors and each color represents a different group. If you want to add something that you can't find or that simply doesn't exist you can use a post-it and write or draw whatever you want. Any question?*

Participant*: No, let's start!*

While the subject is creating his ideal neighborhood the observer is taking notes about his actions and conversations. Many times subjects talk about their creations while building them, either with the person who they're with or with the observer. In order to register everything accurately, there is an official observation sheet that shows all the steps that the observer should follow and complete. The first thing the observer should write down is the age and gender of the subject(s); after that he or she should annotate the group type: if it's a Family, a School Group or Other; In the following parameter the observer has to write down the Visitor Actions: If he or she placed a piece on the tray and then removed it, if they looked at unrelated visitors neighborhood, if they worked alone, with an adult or with a child. Simultaneously the observer should be paying attention to the Visitor's conversations: if he does comments on the proximity or relationships between elements (*I put this next to this because*…), if he assigns value to different aspects of the neighborhood (*I am putting this here because it's important for…* or*, I like this activity so I need this in my neighborhood*) or if he makes comments reviling cost benefit analysis (*I will leave this out so that I can fit in X…*).

Observer: *Now that you've finished do you mind if I ask you some questions?*

Subject: *Sure.*

Observer: 1. *What town and state do you live in?*

2. *Do you live in a house, apartment or condo?*

3. Where would you place your ideal neighborhood? (point to the poster that reflects images of urban, suburban & rural context)

4. Can you briefly describe what you put in your neighborhood and why? Is there anything else that you would have liked to include?

5. In this neighborhood you built where would you live and why (green sticky)? Where would you not like to live and why (red sticky)?

6. Did you put trees or parks in your ideal neighborhood? Why or why not?

7. What types of animals do you think could live in the neighborhood you built?

The first questions were not directly related with the *just* built ideal neighborhood, however they helped us to comprehend and analyze the collected data. Questions 1, 2 and 3 characterize the subject as an individual and explore some of his background, where he comes from. The third question was more interactive, once we were inquiring people of all ages, including children, and sometimes these are not familiar with terms that are considered basic by us adults (Fig.11). Having this in mind, we created three large posters with images of three different environments: Urban, Suburban and Rural. These were modified over the sessions: on the first they were hanging on a huge metallic board that stood on the background of the activity (which was positive because it gave people an idea of what we were doing in a glimpse); the subjects were asked to place their metallic tray underneath their favorite location: Urban, Suburban or Rural (Fig.11); For the second session the poster was re-designed: this time we didn't have the metallic board anymore and ended up hanging the placard on the wall. We were forced into finding a new methodology - we decided to paste a pink post it on the City poster, a blue post-it on the Suburban/Town/Village and a green one on the Countryside. When we asked the participants the third question we also asked where they currently live and so they were given a post it of the color of the place where they actually live in. Then they had to hang the post-it with the color of the place where they currently live underneath the place they would ideally live in. The graphic design was also simplified and got the same visual language as the magnets. An important lesson learned was that when working with subjects that come from a totally different background, it's not important to use the exact correct term or word as the professional field demands. You're not dealing with experts and in order to make average person understand your idea you have to drop the difficult words and focus on explaining the concept. Question 4 invited the subject to explain his choices and motivations and we were more focused on annotating the *whys*. The 5th question asked people about their favorite place within their ideal neighborhood. This might be considered non sense by some and you might want to ask the question *if this is my Ideal Neighborhood why would I not want to live everywhere?* Good Question. Most of the people find essential to have some features although they don't like it. They think it's important to be surrounded by certain elements, gives them security. In the first session we used paper cartoons to represent these places: green for the most wanted and red for the unwanted. In the second session we produced magnetic smiley faces – green stood for the ideal place to live and red for the worse. The third session used the same magnets for the same purpose. Question number 6 aimed to understand how people perceive green space, what were the most valued aspects of having them in a neighborhood and of course what is the role of nature and biodiversity in the urban human context. The 7th question is the less important one for this study and has the purpose of collecting data for the museum although it also informs us how people perceive urban biodiversity and the importance of having habitats within the city.

3.4. Summarizing…

The activity is composed by a magnetic tray and a set of 33 magnets.

Session #1 occurred in the EcoTarium and we interviewed 49 museum visitors. The range of ages differed widely but the dominant group was between 5 and 11 years old.

Session #2 also happened in the EcoTarium but had a different target: Museum staff and workers. We interviewed 16 adults that were mainly between 26 and 65 years old.

Figure 11 – Posters with Urban, Suburban and Rural

Session #3 occurred at the Farmers Market in Worcester. Here we interviewed 20 people, mostly adults aged between 26 and 65.

We interviewed a total of 85 people. The dominant age was between 5 and 11 years old.

3.5. Data analysis methodology

The process of the data analysis was complex (see appendix) and at some moments occurred at the same time as the collection (while collecting session #2 we were still looking at session #1 data). The technique developed for gathering data was similar every session. Each sample had a code number and this number was written in the interview sheet and in the magnetic composition over a post-it.

The first priority was to analyze the pictures of the ideal neighborhood designs. We started by quantifying the number of magnets used, the categories, the % of space occupied and left out blank, etc. This was systematized for all the sessions in an Excel spreadsheet (See appendices Pg. 60 Fig.59).

After this we developed a methodology to sort out the ideal neighborhood designs into categories of patterns and green spaces. We also used Excel to quantify Gender and Age groups.

After this we started to examine the *qualitative data* collected. We started by transcribing all the interviews into a digital format and then grouping the answers by topic. These statements help supporting the results and the discussion of findings.

CHAPTER 4

RESULTS & COLLECTED DATA

This chapter aims to present the information collected during sessions #1, #2, and #3. The programs used for processing the data were computer based, essentially Microsoft Excel and Word. There are 9 aspects to be considered while presenting the results: *average of magnets*, *time*, *age*, *living context*, *housing*, *average of area used*, *average of green spaces magnets used*, *patterns: sequential & spatial*, and *green space typologies*. It's important to note that the majority of the data gathered was transformed into quantitative, especially the individual interviews and personal statements. In order to analyze this data properly and enrich the conclusions we correlated elements (for ex. time vs. gender). The total number of participants in this study is 85, of which 59 belonged to the female gender and 26 to the male. Sometimes participants decide they don't want to answer to certain questions, therefore not all of the aspects that will be analyzed have this '85' number as total participants. The observations were not always conclusive: occasionally participants simply abandon their trays before finishing.

4.1. Data analysis & preferred features

4.1.1. Average of magnets used

Per person per session

Average of magnets used	
#1	18
#2	28
#3	24
Total	**21**

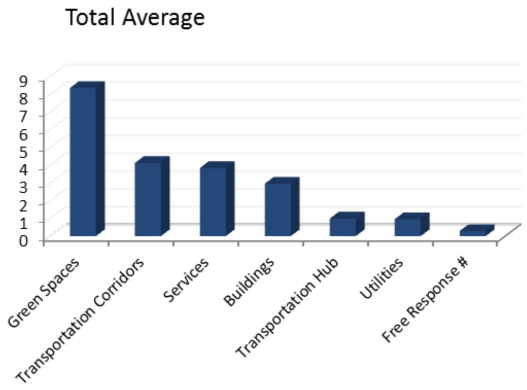
Figure 12 - Average of used magnets

In the table (Fig.12) we display the quantity of magnets each participant used in average in order to build their ideal neighborhood. There were a total of 36 magnets in the set to choose from and, in average each participant used around 21.

Per person per group of magnets

The magnets were organized into groups: *Buildings*, *Green Spaces*, *Services*, *Transportation Corridors*, *Transportation Hub*, and *Utilities*.

The group of Green Spaces (Fig.13) stands clearly out: in average, each participant used around 8 magnets to compose their ideal neighborhood. The second most popular groups are the Transportation Corridors and the Services (Fig.13), both with an average of 4 pieces per participant. The less used ones are the categories of Utilities and Transportation Hub (and of course the Free Response, which is not a real category since is made of a post-it).



	Total Average
Green Spaces	8
Transportation Corridors	4
Services	4
Buildings	3
Transportation Hub	1
Utilities	1
Free Response #	0

Figure 13 - Average of magnets of each category used in each session (both)

4.2.2. Time

Time is an important factor to be considered while presenting the results since one of the requirements expressed in the observation sheet was to measure how many minutes each person took to do the activity.

Gender

Time Average (min)	F	M
	11	12

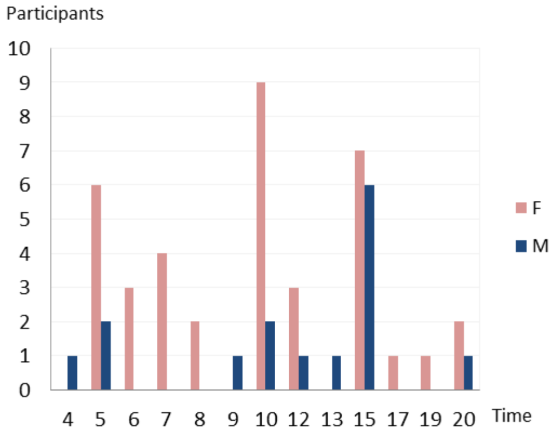


Figure 14 - (Left) Average Time (min) females and males spent building the ideal neighborhood
Figure 15 - (Right) Total Time (min) females and males spent building the ideal neighborhood

As it can be seen in the table (Fig.14) males spend more time than females doing their creations. The maximum time spent around the tray is 20min and it was accomplished by 2 females and one male (Fig.15). The minimum (registered) one spent doing the activity was 4min and this record belongs to a single male. The average time participants, in general devote is 11 min; Females spend around 11 min while males 12.

Age

Average time (min)	0-4	5-11	12-18	19-25	26-65	66+
	-	10	8	15	12	18

Figure 16 - Average time (min) each class of ages spent building their magnetic neighborhood

The main conclusion we take out of this table (Fig.16) is that the younger the participants are, the less (time) they spent building their neighborhoods. We don't have any registered results for children aged less than 4 but between the age of 5 and 11 years old the average time spent doing the activity is 7min. Kids between 12 and 18 years old spent in average around 8min and between 19 and 25 7min. The class between 26 and 65 years old also spent 7min in average. People of 66 years old and older spent a medium of 9min.

4.2.3. Age

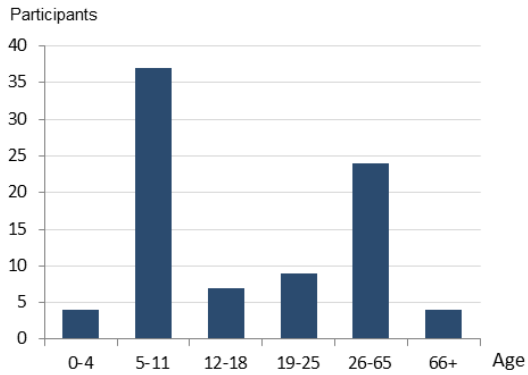


Figure 17 - Participants organized by range of age

In this parameter we pretend to present results related with *Age*. We decided to organize our participants into 6 different classes: 0-4; 5-11; 12-18; 19-25; and 66+.

Per session

Considering all the three prototyping sessions, 44% of the participants interviewed were between 5 and 11 years old; 28% were between 26 and 65 years old. 11% were between 19 and 25; 8% were between 12 and 18; just 5% were 4 or under and 66 or more (Fig.18).

Age	0-4	5-11	12-18	19-25	26-65	66+
#1	8%	73%	12%	0%	4%	2%
#2	0%	0%	0%	31%	56%	13%
#3	0%	5%	5%	20%	65%	5%
TOTAL	**5%**	**44%**	**8%**	**11%**	**28%**	**5%**

Figure 18 - % of participants sorted by class of age and session

Individually, session #1 was dominated by kids aged from 5 to 11 – 73%. There was no record of people between 19 and 25 years old participating in the experiment during this session. Session #2 didn't have any participant under 19. Here, the class between 26 and 65 years old was the one dominating – 56%. Session #3 had 65% participants in this range of ages (26 to 65) and none of 4 or less. In summary, 57% of participants were 18 years and younger, while 44% were adults over 18 years of age.[5]

4.2.4. Living Context

Would like to live in	Total
Urban	36%
Suburban	52%
Rural	13%

Figure 19 - Living context

When the participants finished creating their ideal neighborhoods they were asked where they would ideally prefer to live – if in an urban, a suburban or a rural settlement.
In 85 participants (Fig.19), 21 chose not to answer to this question. The majority, 52% desired to live in a suburban environment. The minority, 13%, elected the countryside (rural) as the best place to live in.

Age

Around 30% of children aged between 5 and 11 prefer to live in a Suburban environment (Fig.20). Teenagers, of ages comprehended between 12 and 18 also prefer to live in a suburban situation. Participants between 19 and 25 years old follow the trend (80%). Participants of 66 and more also prefer to live in this same situation – 75%. The only exception are people aged between 26 and 65 that prefer to live in an urban environment (45%).There is also a high rate of our sample that didn't answer to the question.

[5] The numbers of this table are rounded.

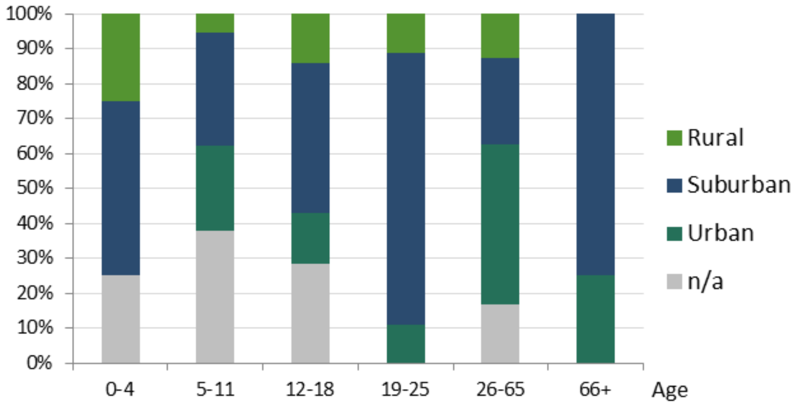


Figure 20 - Living context per age

4.2.5. Housing

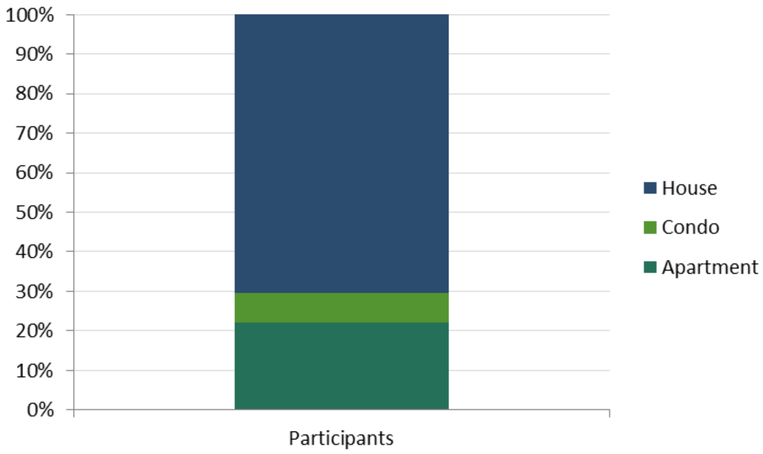


Figure 21 - Housing options per participants in general

One of the questions asked to the participants was related with their living situation. It was significant for the study to understand people's background, where they currently live. Looking to the graphic above (Fig.21) we realized that 70% of the participants of this study lived actually in a house. We can also conclude that condominiums, commonly referred as condo's, aren't the most popular choice among our public since only 6 participants lived in these places. 18 of the individuals that participated in the study currently live in apartments, number that leaves this category in a mid-position on the list.

4.2.6. Average of area used

While counting the magnets of each composition, the idea of calculating areas crossed our minds. As Landscape Architects we found essential to estimate the % of blank vs.

used space and also to calculate the area occupied by each category (Buildings, Utilities, etc.) in every tray.

Blank space | Used space

In order to obtain the results of each session as a whole we had to count each tray as an individual. As it can be seen the participants filled in average, around 65% of their trays with magnets and left 35% in blank (Fig.22). Individually, session #1 is the most balanced: less than 60% of used space in the trays and more than 40% of blank area. In session 2# participants ended up filling their ideal neighborhoods with more magnets – in average 80% of the trays were filled with figures while only 20% was left in blank. When observing the results of session 3#, we notice that the % of used space per tray has a slight drop and decreases to almost 75% while the blank space is now around 25%.

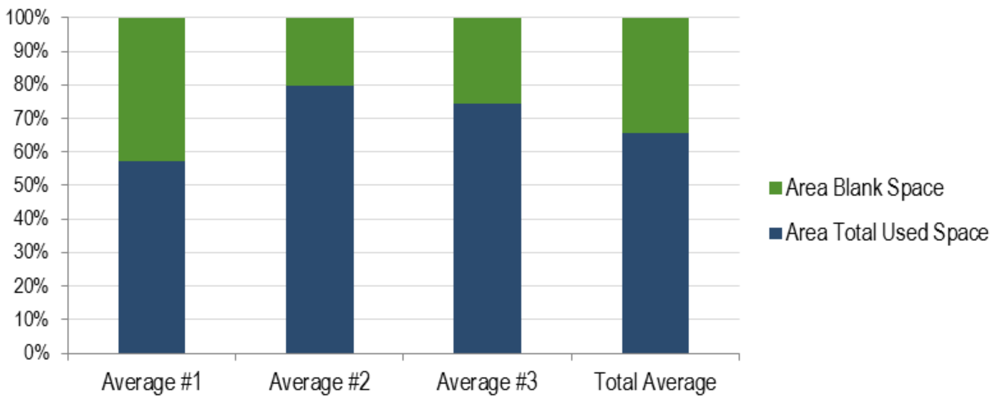


Figure 22 - Average % of blank and used space

Distinct green space & green space connectivity

The term *distinct green space* (DGS) might sound confusing at a first sight but it's actually quite simple. Basically when people are creating their ideal neighborhoods they might choose more than one magnet from the same group (for ex. *Mr. X chose 3*

	Average #1	Average #2	Average #3	Total Average
Distinct green spaces	6	12	7	7
Green space connectivity	4	7	5	5

Figure 23 - Average of DGS and GSC per session

magnets of the group of green spaces in order to build his ideal neighborhood: a park, a playground and a flower garden). The concept of *green space connectivity* (GSC) is different than the one described before considering that this calculates the number of green spaces that are attached to each other (for ex. *if the magnet 'park' is connected with the 'roof garden' one*).

Looking at the table above (Fig.23) we confirm that the average of *DGS* given the three prototyping sessions that occurred, is about 7 different 'green' magnets per participant. In what respects to *green space connectivity* the average number of 'green' pieces attached is around 5 per tray.

4.2.7. Average of 'green' magnets used

As it was recognized before, the 'green' group represents the highest average number of magnets used per participant. Looking at the graphic below (Fig.24) we can see that this category consists of 16 different magnets. The most used one is the *large native tree*, considering that 8 out of 10 participants selected this piece to build their ideal neighborhood. The less used magnets were the *cemetery* and the *vacant lot* since only 2 out of 10 people chose to use them in their creations. The graphic below (Fig.14) gives us an idea of the total number of times each of 'green' magnet has been used.

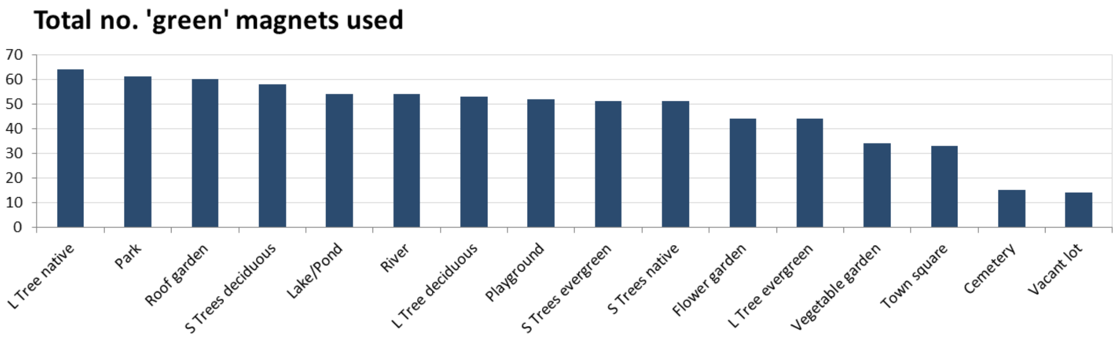


Figure 24 - Total no. of green magnets used in the whole study

4.2.8. Patterns: Sequential & Spatial

After collecting the data and starting to analyze the numbers we felt the need of finding a way to categorize the patterns and forms found in the trays. Supported by the pictures we took to every composition we went to seek inspiration in Appleyard's (1982) work (Pg. 40) that describes the structural quality of mental maps that participants created for a particular urban neighborhood.

Sequential

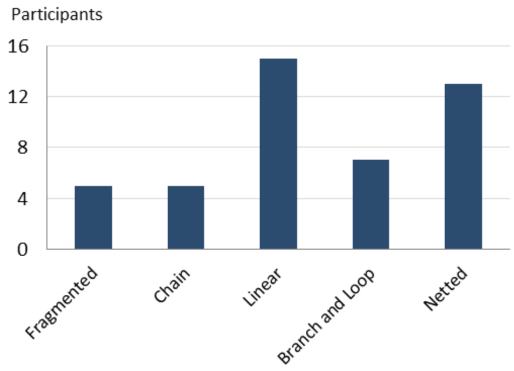


Figure 25 - Sequential's sub classes

This category is composed by 5 sub-categories (Fig.25). The most common pattern is *linear* and *netted*. *Fragmented* and *chain* are the less frequent, maybe because of being the most simple.

Spatial

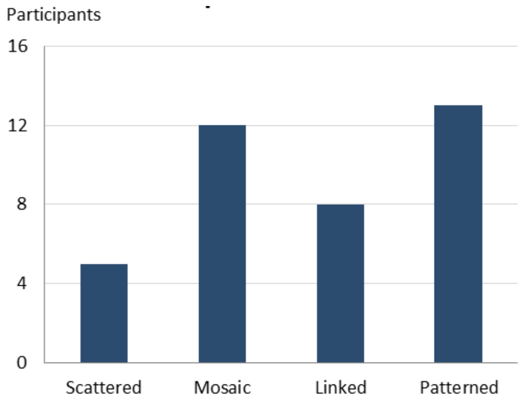


Figure 26 - Spatial's sub-classes

There are 4 sub-categories in Spatial's mode (Fig.26). Accordingly to the graphic, in this category the most usual form of construction is the *patterned*. The less common one is the *scattered,* again the most simple of the 4.

Sequential vs. spatial

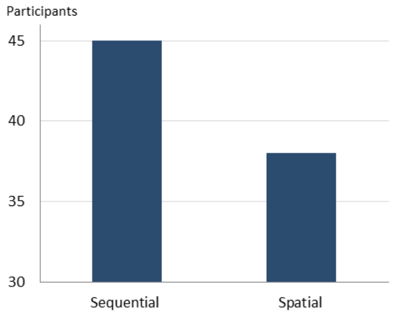


Figure 27 - Sequential vs. Spatial

As it can be seen in the graphic (Fig.27) *sequential* patterns are more common than *spatial* – 45 against 38.

Age

PATTERN	0-4	5-11	12-18	19-25	26-65	66+
Sequential						
Fragmented	1	4	-	-	-	-
Chain	-	3	-	-	2	-
Linear	1	7	3	1	2	1
Branch and Loop	-	2	-	2	2	1
Netted	-	5	1	3	3	1
Spatial						
Scattered	-	3	-	-	2	-
Mosaic	1	3	1	-	6	1
Linked	1	3	-	1	3	-
Patterned	-	6	1	2	4	-

Figure 28 - Sub-types of patterns by class of ages

In the group of ages of 4 and less there's no specific pattern that stands out (Fig.28). The kids between 5 and 11 years old are distinguished by building a majority of neighborhoods accordingly to the pattern of *sequential-linear.* The same happens with the echelon of people aged between 12 and 18. The participants of ages between 19 and 25 have more compositions in the category of *sequential-netted*. The class of ages between 26 and 65 has more people creating neighborhoods accordingly to the *spatial-mosaic* style. The group of 66 years old and more do not emphasize any category. In general, it appears that the more "sophisticated" or complex patterns were made by older participants.

4.2.9. Green space typologies

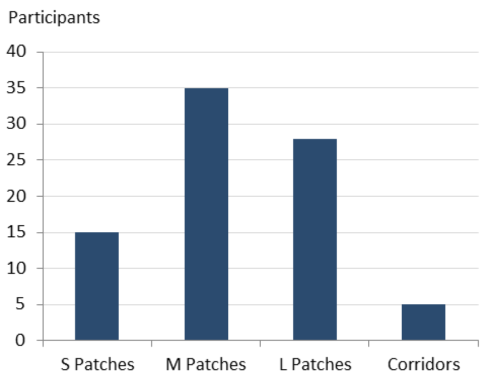


Figure 29 - Green space typologies by participant

As Landscape Architects we felt the need to develop a methodology for categorizing green spaces (Pg. 43). Accordingly with Dramstad *et. al.* (1996) we have adapted 4 typologies to our study (Fig.29). The most observed one were *medium patches.*

Gender

	F	M
S Patches	7	8
M Patches	27	8
L Patches	20	8
Corridors	3	2

Figure 30 - Green space typologies by gender

The most frequent form of organizing green space by women is through medium patches. Men are divided when it comes to organize their green areas: scattered patches, medium patches and large patches (Fig.30).

Age

Having a look at the table below (Fig.31) and considering all possible types of organization we identify *large patches* as the most used one and among kids of 5 to 11 years old.

	0-4	5-11	12-18	19-25	26-65	66+
S Patches	2	10	-	-	3	-
M Patches	1	11	5	5	10	3
L Patches	-	13	1	4	10	-
Corridors	1	2	-	-	1	1

Figure 31 - Green space typologies by age

CHAPTER 5

DISCUSSION OF FINDINGS

In this chapter we discuss the results displayed in the previous points of chapter 4. We organized this discussion by theme so that it is easier to follow.

5.1. Analysis

- **Average of magnets used**

Per person per session

A factor to be considered when reflecting about available space and number of magnets used is the size of the magnetic tray (13”x9”). So, having in mind that the given space is limited from the start, we have to recognize that the number of magnets used will be influenced by this condition. The fact that each participant uses in average 21 magnets per composition gives us, as exhibit developers, an idea of how many magnets the participants feel comfortable using considering that they have 33 possibilities available. Thus, it also suggests that it is not possible to use all the magnets available in the limited space. The exhibit designers did this intentionally to be able to study the trade-offs that people need to make between different land uses in a limited space, which is similar to the reality of planning where land areas are limited

This result can also guide other museums or entities working in similar projects.

Per person per group of magnets

Accordingly to the results, the category of green spaces is the most popular one – participants use an average of 8 ‘green’ magnets per tray. In view of this, we might conclude people know they need nature to live in harmony, even in constructed environments like cities. This is supported in the literature where parks and green spaces are important benefits that people look for in neighborhoods.

“It seems so obvious to me. To human emotional and psychological health is critical being close to nature. We’re not designed to live totally surround by concrete.”

Statement of a participant when asked about green spaces

Another interesting aspect is the fact that people seem to be aware of the importance of bicycle lanes, pedestrian sidewalks and trails. Observing this in the US was surprising since the level of density in towns and suburbs is quite low (Sholomo and others, 2011).

- **Time**

This parameter might reflect the time people end up spending in the EcoTarium in general. Here we will analyze time in order to know how many minutes each participant took to do the activity.

When analyzing the results we found that no participants ‘played’ less than 4 minutes in the exhibit (Fig.15). One of the references used by the museum exhibit developers is that each visitor spends around 2 min in a non-monitored (without the presence of a supervisor) museum section. We know that the visitors who accepted to participate in the ideal neighborhood prototyping activity spent almost double this average time engaged. They spent a minimum of 4 minutes on the exhibit, number that reflects and shows the “success” of this prototype. We might also hypothesize that longer time spent at an exhibit may increase substantially the knowledge absorbed or informal learning. This time related data might also contribute and help other museums outlining their exhibits.

Gender & Age

Regarding the total time (in min.) our participants spent doing the activity, we observed that in general, females stayed focused for longer periods of time. Is their attention span wider than males? Some say so but nothing’s proved yet, however, some research suggests different learning styles or problem-solving skills with females being more collaborative and reflective, which may support this sustained attention span. During the sessions, we remarked that participants seemed to have different rhythms while building their ideal neighborhood. There was also a high rate of people that looked at other’s trays, possibly seeking for inspiration or a better strategy and some even acted as if they were on a test or a competition. The fact is, the older participants were, the longer they spent doing the activity.

- **Age**

This is one of the most important factors in the study since it makes us, as investigators, to reflect about who’s our public, our target in this mission. Recognizing kids from 5 to 11 years old as the main visitors of the museum encourages us into adopting appropriate strategies to keep them around as much as possible. Their parents belong to an important class (of ages) too. It should be remembered that one of the aims of the project is to involve people, to make them learn together, regardless of their ages. Having 44% of kids as the majority of the sample (Fig.18) gives us hope: we believe it’s easier to influence and promote these concepts in early stages of life.

- **Living context**

In order to understand better the participant's vision about the ideal neighborhood we felt the need of asking where they would ideally prefer to live – if in a suburban, an urban or a rural context. Observing Fig.19 we learnt that the majority of the participants would prefer to live in a suburban environment. Session 1# and 2# took place in the museum and the fact that it's located in a quiet area of Worcester might have influence in the results. Session #3 took place in the heart of Worcester, in the Farmer's market and still people preferred the suburbs as place to settle.

Age

It was a surprise to learn that the majority of the participants between 18 and 25 years old preferred to live in a suburban context (Fig.20). This is a bit surprising in the sense that some studies have suggested that the demographic of young adults prefers urban living. One influencing factor could be that many study participants indicated they currently lived in the suburbs. This preference for suburbs mirrors a long held trend in the United States since World War II when the post-war building boom led to a migration from the central cities to the suburbs. In fact in most metropolitan regions there are more people living in the outlying suburbs than in the central city. It's seen as a smaller place, where people can get better life-quality, move around easier, maybe without car, and most of all expenses tend to be lower.

- **Housing**

It was an interesting experience to get to know participants housing situation. We were not expecting that 57 out of 85 people lived in single family houses. This number reflects American housing reality and supports the results displayed in *Living Context* – people prefer living in the suburbs therefore they choose to live in a house. Other conclusion we can reach out with this numbers is connected with the fact that the green spaces were the most popular category. In short, our participant's choices reflect they want more green spaces, prefer to live in the suburbs and in single family houses. In addition, even those who may want to live in cities may prefer to live in a single-family home.

- **Average of area used**

Blank space and Used space

An aspect we would like to analyze is the blank space phenomena. It's curious that children on average left much more blank space than adults. One of the goals was to understand the meaning of this unfilled space. Some kids were questioned about the meaning of this areas and the answer was consecutively the same: *"green space", "forest", "it's a place for trees to grow"*. Blank space was always associated with green areas for public recreation. Adult's reaction was different. They tended to fill their trays until there was no more space left. Generally their creations were more organized. This reflects that adult's and child's minds work differently: they have a different concept of organizing space.

Distinct Green Spaces (DGS) and Green Space Connectivity (GSC)

These concepts are also explored in this section since they are a sort of 'area' too. In DGS participants tended to use, on average 7 distinct 'green' magnets. This means that people want variety, more green spaces around them. One of the participants was very expressive about this specific topic:

"Yes, I love them. In Europe there's a park in every neighborhood. I live in an area where the nearest park is about 4/5 miles. It has trees but not really park."

Testimonial of a participant during session 2# when asked about green spaces

Considering GSC, people attached in average 5 'green' magnets together. This is a considerable amount of space per tray since that the average in other categories is around 2. We can conclude that participants value the green *continuum*, they want green areas to be solid and cohesive in their neighborhoods.

- **Average of 'green' magnets used**

As landscape architects we found imperative to know with detail which were the most and the least valued 'green' magnets. For example, in session 2# people used in average almost 12 'green' pieces per tray – an incredibly high number if we consider that the total average is 28 magnets per composition. This reflects that participants recognize the importance of green space in their living context. They know it's essential for the environment, for health, for social bonding, for protection, for the development of biodiversity, for leisure, general well-being (and so one). Some of the adult participant's statements were important to prove this point:

"I used a lot of green spaces because I think this is a very important aspect of a city/town. They build a sense of community and can be used as outdoor classrooms for schools."

"Trees and parks are important from an environmental standpoint and they also add to the quality of life."

"I added a lot of natural conservation spaces as well as green spaces you would find in cities. There is a natural progression from wild lands to parks and vegetable gardens. These are important in a community!"

Considering the 'green' magnets individually we observed that the most used ones are the trees, parks and the new trendy roof garden. These results reflect the idea expressed before, that people like the idea of having roof gardens. They might think they can have nature *in* their apartments, they're gradually acting 'greener (Harrison, 2010)

- **Patterns: Sequential & Spatial**

After processing all the data into established parameters we felt there was still something missing. Inspired by Appleyard's model (1982) we decided to (re)create a technique that would guide us into reading people's trays consistently. With this in mind and motivated by Appleyard's plans for Ciudad Guayana we've agreed to adapt and remodel his concepts of analyzing maps, divided into 2 categories and named as sequential and spatial. In order to simplify the identification of patterns through the tray's pictures we felt the need of generating the following schemes.

Sequential patterns

The category of sequential is defined by having roads as the structural element. There are 5 sub classes, sorted by order since their configuration gets more complex as it moves forward: fragmented, chain, linear, branch and loop and at last netted.

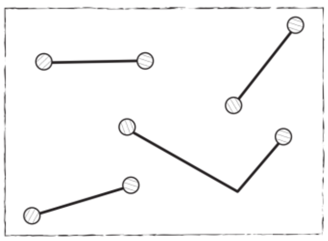
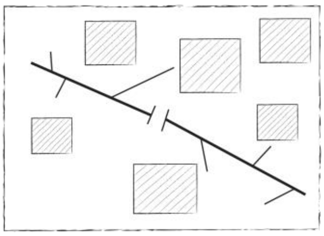


Figure 32 - Sequential-Fragmented

<u>Fragmented</u>

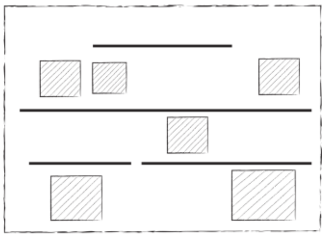
Small sequences of elements connected by roads or paths



Chain

Connected by one main road or path

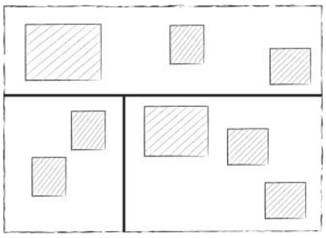
Figure 33 - Sequential-Chain



Linear

Roads or Paths organized in a parallel way;

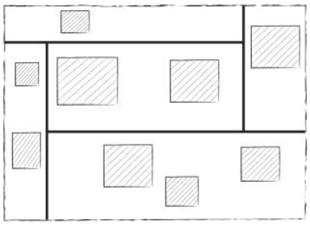
Figure 34 - Sequential-Linear



Branch and Loop

Partial gridded with a reduced number of individual blocks (1-3 blocks)

Figure 35 - Sequential-Branch and Loop



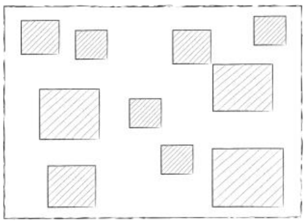
Netted

More blocks than before (4 or more)

Figure 36 - Sequential-Netted

Spatial patterns

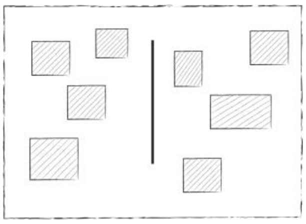
This category is characterized for being formed by individual buildings or constructions. It's organized in 4 sub classes, once again disposed by level of complexness: scattered, mosaic, linked and patterned. For example, scattered in its most simple form, is formed by disperse magnets and basic or nonexistent connections (roads).



Scattered

Isolated pieces; Basic connections

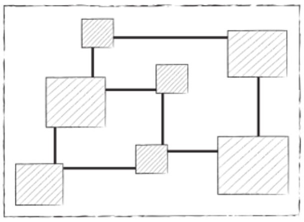
Figure 37 - Spatial-Scattered



Mosaic

Couple small connections, units are still dispersed; Organized by districts

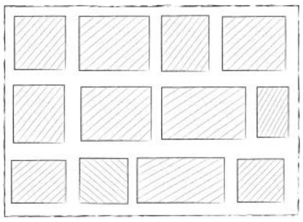
Figure 38 - Spatial-Mosaic



Linked

Pieces are more connected to one another

Figure 39 - Spatial-Linked



Patterned

More districts and organization than before; Roads are not the organizing element

Figure 40 - Spatial-Patterned

Accordingly with Lynch's (1960) work, a city or a neighborhood can be understood and structured by different elements including nodes, landmarks, districts, edges and boundaries; and furthermore these elements can be organized in, either sequential or spatial patterns. In this project's case sequential patterns were more common. This leads us to the thought that in general, people might feel more comfortable and guided when using structural defining elements like roads. An additional fact is that participants under 18 years old tend to construct more neighborhoods accordingly with the sequential mode. Adults are more spatial. Do children's minds tend to be more structural and maybe more systematized than grown-ups? We would have to analyze more results in order to support this claim but apparently yes. Within the *Sequential* category, *Linear* and *Netted* were the most frequent patterns. In the *Spatial* typology *Mosaic* and *Patterned* were the most common. The fact that in both categories the most complex pattern was amongst one of most frequent ones can only reflect one thing: people perceive their neighborhoods as complex structures. We have assembled some examples accordingly to the participant's creations:

Figure 48 - Sequential-Fragmented

Figure 49 -Sequential-Chain

Figure 46 - Sequential-Linear

Figure 45 - Sequential-Branch and Loop

Figure 47 - Sequential-Netted


Figure 44 - Spatial-Scattered

Figure 43 - Spatial-Mosaic

Figure 42 - Spatial-Linked

Figure 41 - Spatial-Patterned

- **Green Spaces Typologies**

As landscape architects we decided to develop a methodology for analyzing the category of green spaces and how they are disposed and organized in the trays.

We got inspired by the book of Dramstad, Olson and Forman (1996). This manual is a good reference in terms of landscape ecology and having this in mind we've adapted their concept of patches, edges & boundaries, corridors and mosaics to our reality. We created 4 types of possible forms of green spaces: scattered patches, medium patches or clumps, large patches or blocks and corridors

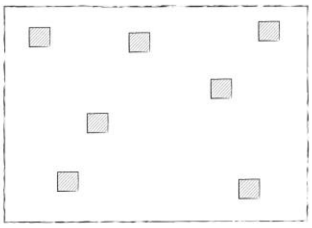


Figure 50 - Scattered patches

<u>Scattered patches</u>

Dispersed elements

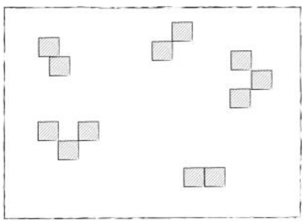
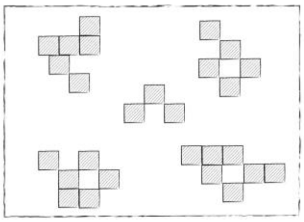


Figure 51 - Medium patches

<u>Medium patches - clumps</u>

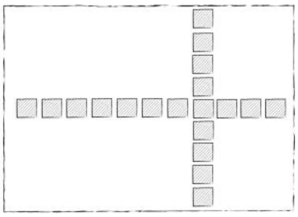
Green blocks together (1-3)



Large patches - blocks

Multiple green blocks together (4 or more)

Figure 52 - Large patches



Corridors

Magnets organized in line

Figure 53 - Corridors

Kids aged between 5 and 11 years old see green space as hole, as large defined area: they tend to organize it in large patches. Teenagers and young adults (12-25 years old) have a slightly different angle: they organize green space in medium patches or clumps. Adults are not decided: they tend to organize their green spaces in 2 forms, medium and large patches.

These results reflect how the participants perceive green space. They come in line and confirm the results presented in *GSC*: people have a more holistic view about green areas. 63 out of 85 participants organized their green space in medium or large patches. Isn't this an obvious sign?

- **Conclusion**

We found interesting to finish this chapter with the creation of a model that could reflect the choices and preferences of the 85 participants that have collaborated in the study. The following image is a simulation based on the collected data and we took into consideration the average of magnets used, categories, green space typologies and patterns (Fig.54)

Figure 54 - Simulation of the ideal neighborhood, based on the participants preferences

5.2. Opportunities for Future Research & Potential Developments

It's essential to underline that this is an ongoing project, expected to be operational in 2016. The results presented belong to the first round of prototyping sessions. In order to launch the exhibit in the predicted date it's necessary to continue this work, to keep collecting and analyzing data.

This project provides many opportunities for short and long term research: starting with the development of new but related contents; promoting an original learning process – *informal learning*; and continuing this modern, synergic type of investigation.

It would be interesting to continue developing strategies that combine the field of Landscape Architecture and Social Sciences. In these areas, it is inevitable an attempt to understand what people want, what's their perception about public spaces and green areas. It's gratifying to know the first steps are given and that we've obtained palpable results.

Going back to the *ideal neighborhood* exhibit, it would be valuable to start thinking about a final product, a vision for the future. Until now, we have been *playing* in 2 dimensions but we believe the future is in 3D. The options are to continue with the magnets or a similar material or to develop a computer based program (maybe a touch screen). Our insight would be to leave it in the real, tangible world.

Other important aspect is related with the message that the exhibit is capable of transmitting. What could people learn while visiting the museum? Working in this project made us reflect about the importance of the contents. It is imperative to integrate the concept of *informal learning* especially in the end, as a conclusion when visitors finish building their ideal neighborhood.

In a short period panorama we believe there is room for developing a mechanism that could show the participants some type of result of their neighborhood. With this in mind, the idea would be to develop a sort of mobile application (app), just like a computer program that could be downloaded from any smartphone, mobile device or tablet. This software would have an integrated bar code reader that would scan every ideal neighborhood built. After the scanning process, the app could be used to compare the participant's creations.

Eventually it could measure how green or energy efficient each neighborhood is. It could also give hints and tips on how, for example, to become more environmentally friendly (Fig.55). There are advantages in creating such a tool: first, the exhibit would become more appealing and interactive. We are in the beginning of a digital era and accordingly with Pew Research Center more than 60% of Americans have a smartphone and 42% own a tablet. This system would allow the visitors to keep the app in their devices, take it

Figure 55 - Simulation of the possible look of an app for smartphones in the context of the ideal neighborhood design

home, and probably think over the suggested tips and given info in a different environment (not in the museum floor with a hundred kids screaming and running around). Another advantage would be to have the possibility to share the results in the social networks (Facebook, Instagram, Pinterest, etc.) and take advantage of the digital advertising to publicize the EcoTarium. This app could have different sections and serve the diverse exhibits of the museum simultaneously.

CONCLUSION

The project *Pathways: From the Lab to the Neighborhood: An Interactive Living Exhibit for Advancing STEM Engagement with Urban Systems in Science Museums* began in the end of last year and is the result of a partnership between three American Universities and a Science museum, the EcoTarium. The alliance of a multidisciplinary team of this caliber can only bring progress and dignity to the project and its sponsor (NSF). It allows professionals of different, but related areas, to share information, methodologies, and techniques of work.

This project and the *City Science* exhibit have explored successfully the relationship between people and the urban environment. Clearly, the ideal neighborhood section is one of the main parts of this exhibit. The success of the implemented model proved that people were interested in participating and curious about the development of new features to come. Thanks to their contribution we accomplished one of the main goals: the collection of data.

By creating appealing and easy-to-read magnets we ensured participants attention and kept them longer with us. The idea is that, independently from their age we would like those to ‘take something’ home, to wake their environmental conscience, to endorse wisely this concept of informal learning.

When we started prototyping the ideal neighborhood exhibit, our objective was to comprehend how people perceive space, how they look to their neighborhoods and public areas. We realized our participants act and think differently depending on age, gender, and place of the interview. The effect of promoting a friendly and exciting atmosphere at the site is beneficial. Kids and adults become completely absorbed as soon as they start ‘playing’. Children end up solidifying concepts and knowledge acquired in previous situations (for ex. in classroom, TV or at home). Handing out a ‘reward’ in the end of the activity proved to be a good motivational strategy. We gave our participants a kind of passport so that they could stamp different shapes in the prototyping station.

The magnetic models and protocols tested proved to work well. Around 70% of the participants used green magnets: trees, parks and *roof gardens* were among the most used pieces. A vast majority of the visitors also confessed preferring to live in a single-family house, located in a suburban context and with more access to green infrastructures. The emphasis given (by the participants) to the green space category was inspiring. It was the most used group by far and this can only mean one thing: people want to live closer to nature. With these results we concluded how valuable green spaces are to the community.

Questions related to urban concerns and environmental problems have been increasing world-wide in the last few years. This brings us back to the City Science theme: What do human beings expect for the future? Are people *really* aware of the impacts that climate change can cause? That's one of the reasons this exhibit is being set: to explain people this *new* reality that is affecting (or will soon) their lives. In two years the exhibit will be on the floor but once it's ready the mission will continue: the goal will be to replicate this pilot project in other museums. International eyes are observing and Europe might want a chance too. Portugal could also embrace a project of this kind.

We can conclude that the goals for this dissertation were achieved. This is an innovating project that proved to fit well along with the field of Landscape Architecture. Apparently it could easily be a new output for this profession and it's obviously an area that would benefit of more investigation. We designed a methodology for gathering data that works simultaneously as an exhibit model but there's still much to do. The consistency given by the cultivation of an aesthetical and practical sense was one of the keys for innovating and promoting new practices.

As a final note, it's noteworthy to mention that this project combined fruitfully the fields of Social Sciences and Landscape Architecture. Since it's an ongoing project and that the results expressed are subject to changes, we hope that researchers of these both fields keep working with synergy and complicity in order to achieve even more results in the future.

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WEB

https://www.hampshire.edu/faculty/timothy-zimmerman
Consulted in 22.09.14 at 11.20h

http://www.nytimes.com/2013/11/24/opinion/sunday/art-makes-you-smart.html?_r=0
Consulted in 21.09.14 at 00.20h

http://www.pewinternet.org/fact-sheets/mobile-technology-fact-sheet/
Consulted in 22.09.14 at 23.35h

APPENDICES

1. OBSERVATION & INTERVIEW SHEETS

(Front Page)

City Science – Magnetic Neighborhood – Adult V04182014

Observation Sheet

Version#: ________________ Observation#: ______________

Observer:____________________

Date:______________________

Start: ____________________

Finish: __________________

Age:	<4	5-11	12-18	18-25	26-65	66+
F						
M						

Group Type:

☐ Family ☐ School Group Other: ___________________

Visitor Actions

☐ Placed piece on the board and then removed a it

☐ Looked at unrelated visitors neighborhood

Worked Alone ☐

Worked with adult ☐

Worked with child ☐

Notes…

Usability…

Visitor Conversation

☐ Comments on proximity/relationships between elements. (*I put this next to this because…)*

☐ Assigns value to different aspects of the neighborhood. (*I am putting this in because it is important, or I like x activity so I need this in my neighborhood)*

☐ Makes a comment revealing cost benefit analysis *(I will leave this out so I can fit in x)*

(Back Page)

City Science – Magnetic Neighborhood – Adult V04182014

Interview Sheet

Observation#: ____________________

Observer: ________________________

Date: ____________________________

What town, state do you live in?____________________

Do you live in a: ☐ house ☐ apartment ☐ condo

- Can you briefly describe what you put in your neighborhood and why? Is there anything else that you would have liked to include?
- In this neighborhood you built where would you live and why (green sticky)? Where would you not like to live and why (red sticky)?
- Did you put trees or parks in your ideal neighborhood? Why or why not?
- What types of animals do you think could live in the neighborhood you built?

This was the sheet used for collecting the data through the magnetic prototypes. Participants were interviewed after they finished building their ideal neighborhood. They were asked to explain their choices and motivations.

2. PHOTO BOOKLET

We have organized a ‘photo album’ for the prototyping sessions #1, #2 and #3. These demonstrate how the sessions were conducted, the approach to the visitors and the collection of data.

Session #1

Figure 56 - Pictures took during Session #1

Session #2

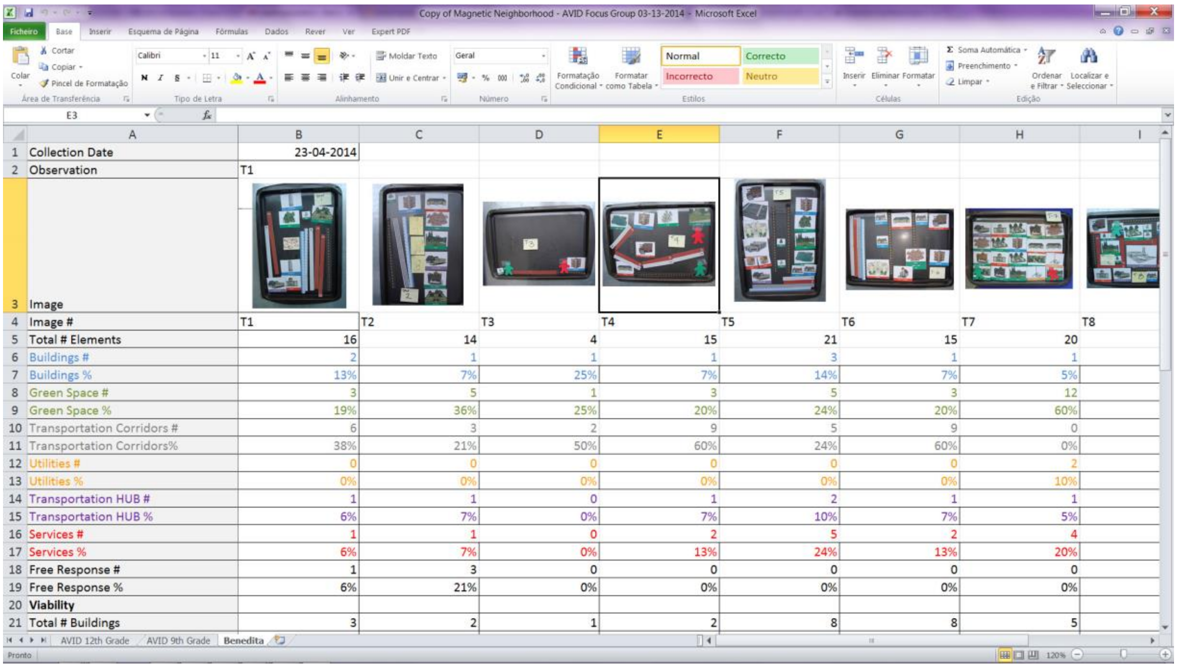
Figure 57 - Pictures took during Session #2

Session #3

Figure 58 - Pictures took during Session #3

3. ANALYSIS

The intention here is to provide some extra information about the analysis. The first image is a print screen of an excel sheet used to process data.



	A	B	C	D	E	F	G	H	I
1	Collection Date	23-04-2014							
2	Observation	T1							
3	Image								
4	Image #	T1	T2	T3	T4	T5	T6	T7	T8
5	Total # Elements	16	14	4	15	21	15	20	
6	Buildings #	2	1	1	1	3	1	1	
7	Buildings %	13%	7%	25%	7%	14%	7%	5%	
8	Green Space #	3	5	1	3	5	3	12	
9	Green Space %	19%	36%	25%	20%	24%	20%	60%	
10	Transportation Corridors #	6	3	2	9	5	9	0	
11	Transportation Corridors%	38%	21%	50%	60%	24%	60%	0%	
12	Utilities #	0	0	0	0	0	0	2	
13	Utilities %	0%	0%	0%	0%	0%	0%	10%	
14	Transportation HUB #	1	1	0	1	2	1	1	
15	Transportation HUB %	6%	7%	0%	7%	10%	7%	5%	
16	Services #	1	1	0	2	5	2	4	
17	Services %	6%	7%	0%	13%	24%	13%	20%	
18	Free Response #	1	3	0	0	0	0	0	
19	Free Response %	6%	21%	0%	0%	0%	0%	0%	
20	Viability								
21	Total # Buildings	3	2	1	2	8	8	5	

Figure 59 - Print Screen of an Excel analysis sheet

The graphic bellow offers additional information about the results of other category of spaces like Transportations Corridors, Services, Buildings, Transportation Hub, Utilities and Green Spaces.

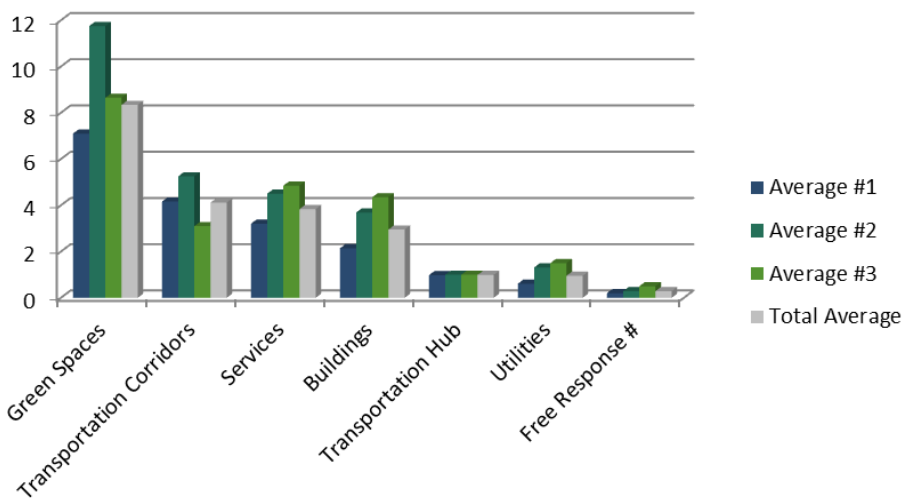


Figure 60 - Distribution of all categories of space proposed organized by session